This key should allow you to understand why you choose the option you did (beyond just getting a question right or wrong). More instructions on how to use this key can be found here.

If you have a suggestion to make the keys better, please fill out the short survey here.

Note: This key is auto-generated and may contain issues and/or errors. The keys are reviewed after each exam to ensure grading is done accurately. If there are issues (like duplicate options), they are noted in the offline gradebook. The keys are a work-in-progress to give students as many resources to improve as possible.

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1. Simplify the expression below into the form $a + bi$. Then, choose the intervals that a and b belong to.

$$(-9 + 6i)(-3 - 7i)$$

The solution is $69 + 45i$, which is option B.

A. $a \in [27, 36]$ and $b \in [-42.6, -39.8]$

$27 - 42i$, which corresponds to just multiplying the real terms to get the real part of the solution and the coefficients in the complex terms to get the complex part.

B. $a \in [63, 72]$ and $b \in [42.5, 48.1]$

* $69 + 45i$, which is the correct option.

C. $a \in [63, 72]$ and $b \in [-45.8, -44.8]$

$69 - 45i$, which corresponds to adding a minus sign in both terms.

D. $a \in [-15, -12]$ and $b \in [77.3, 81.3]$

$-15 + 81i$, which corresponds to adding a minus sign in the first term.

E. $a \in [-15, -12]$ and $b \in [-81.8, -80.1]$

$-15 - 81i$, which corresponds to adding a minus sign in the second term.

General Comment: You can treat i as a variable and distribute. Just remember that $i^2 = -1$, so you can continue to reduce after you distribute.

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2. Simplify the expression below and choose the interval the simplification is contained within.

$$2 - 14^2 + 15 \div 1 * 13 \div 11$$

The solution is -176.273, which is option C.

A. $[-193.9, -191.9]$

-193.895, which corresponds to an Order of Operations error: not reading left-to-right for multiplication/division.

B. $[196.1, 205.1]$

198.105, which corresponds to two Order of Operations errors.

C. $[-182.27, -169.27]$

* -176.273, this is the correct option

D. $[214.73, 220.73]$

215.727, which corresponds to an Order of Operations error: multiplying by negative before squaring. For example: $(-3)^2 \neq -3^2$

E. None of the above

You may have gotten this by making an unanticipated error. If you got a value that is not any of the others, please let the coordinator know so they can help you figure out what happened.

General Comment: While you may remember (or were taught) PEMDAS is done in order, it is actually done as P/E/MD/AS. When we are at MD or AS, we read left to right.

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3. Choose the **smallest** set of Complex numbers that the number below belongs to.

$$\frac{0}{-12\pi} + \sqrt{6}i$$

The solution is Pure Imaginary, which is option B.

A. Rational

These are numbers that can be written as fraction of Integers (e.g., -2/3 + 5)

B. Pure Imaginary

* This is the correct option!

C. Not a Complex Number

This is not a number. The only non-Complex number we know is dividing by 0 as this is not a number!

D. Nonreal Complex

This is a Complex number ($a + bi$) that is not Real (has i as part of the number).

E. Irrational

These cannot be written as a fraction of Integers. Remember: π is not an Integer!

General Comment: Be sure to simplify $i^2 = -1$. This may remove the imaginary portion for your number. If you are having trouble, you may want to look at the *Subgroups of the Real Numbers* section.

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4. Choose the **smallest** set of Real numbers that the number below belongs to.

$$\sqrt{\frac{64}{121}}$$

The solution is Rational, which is option E.

A. Whole

These are the counting numbers with 0 (0, 1, 2, 3, ...)

B. Irrational

These cannot be written as a fraction of Integers.

C. Not a Real number

These are Nonreal Complex numbers **OR** things that are not numbers (e.g., dividing by 0).

D. Integer

These are the negative and positive counting numbers (..., -3, -2, -1, 0, 1, 2, 3, ...)

E. Rational

* This is the correct option!

General Comment: First, you **NEED** to simplify the expression. This question simplifies to $\frac{8}{11}$.

Be sure you look at the simplified fraction and not just the decimal expansion. Numbers such as 13, 17, and 19 provide **long but repeating/terminating decimal expansions!**

The only ways to *not* be a Real number are: dividing by 0 or taking the square root of a negative number.

Irrational numbers are more than just square root of 3: adding or subtracting values from square root of 3 is also irrational.

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5. Simplify the expression below and choose the interval the simplification is contained within.

$$14 - 9^2 + 3 \div 7 * 8 \div 4$$

The solution is -66.143, which is option B.

A. $[95.76, 96.27]$

95.857, which corresponds to an Order of Operations error: multiplying by negative before squaring. For example: $(-3)^2 \neq -3^2$

B. $[-66.87, -65.79]$

* -66.143, this is the correct option

C. $[94.97, 95.85]$

95.013, which corresponds to two Order of Operations errors.

D. $[-67.26, -66.98]$

-66.987, which corresponds to an Order of Operations error: not reading left-to-right for multiplication/division.

E. None of the above

You may have gotten this by making an unanticipated error. If you got a value that is not any of the others, please let the coordinator know so they can help you figure out what happened.

General Comment: While you may remember (or were taught) PEMDAS is done in order, it is actually done as P/E/MD/AS. When we are at MD or AS, we read left to right.

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6. Choose the **smallest** set of Real numbers that the number below belongs to.

$$-\sqrt{\frac{484}{49}}$$

The solution is Rational, which is option A.

A. Rational

* This is the correct option!

B. Whole

These are the counting numbers with 0 (0, 1, 2, 3, ...)

C. Irrational

These cannot be written as a fraction of Integers.

D. Integer

These are the negative and positive counting numbers (..., -3, -2, -1, 0, 1, 2, 3, ...)

E. Not a Real number

These are Nonreal Complex numbers **OR** things that are not numbers (e.g., dividing by 0).

General Comment: First, you **NEED** to simplify the expression. This question simplifies to $-\frac{22}{7}$.

Be sure you look at the simplified fraction and not just the decimal expansion. Numbers such as 13, 17, and 19 provide **long but repeating/terminating decimal expansions!**

The only ways to *not* be a Real number are: dividing by 0 or taking the square root of a negative number.

Irrational numbers are more than just square root of 3: adding or subtracting values from square root of 3 is also irrational.

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7. Simplify the expression below into the form $a + bi$. Then, choose the intervals that a and b belong to.

$$\frac{-18 - 55i}{1 - 6i}$$

The solution is $8.43 - 4.41i$, which is option C.

A. $a \in [-18.5, -17.5]$ and $b \in [8, 9.5]$

$-18.00 + 9.17i$, which corresponds to just dividing the first term by the first term and the second by the second.

B. $a \in [311, 313]$ and $b \in [-5.5, -3.5]$

$312.00 - 4.41i$, which corresponds to forgetting to multiply the conjugate by the numerator and using a plus instead of a minus in the denominator.

C. $a \in [7.5, 9.5]$ and $b \in [-5.5, -3.5]$

* $8.43 - 4.41i$, which is the correct option.

D. $a \in [-9.5, -8.5]$ and $b \in [0.5, 2.5]$

$-9.41 + 1.43i$, which corresponds to forgetting to multiply the conjugate by the numerator and not computing the conjugate correctly.

E. $a \in [7.5, 9.5]$ and $b \in [-163.5, -162]$

$8.43 - 163.00i$, which corresponds to forgetting to multiply the conjugate by the numerator.

General Comment: Multiply the numerator and denominator by the *conjugate* of the denominator, then simplify. For example, if we have $2 + 3i$, the conjugate is $2 - 3i$.

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8. Simplify the expression below into the form $a + bi$. Then, choose the intervals that a and b belong to.

$$\frac{45 - 88i}{-3 + 4i}$$

The solution is $-19.48 + 3.36i$, which is option A.

A. $a \in [-20.5, -18]$ and $b \in [1.5, 5]$

* $-19.48 + 3.36i$, which is the correct option.

B. $a \in [-16, -14.5]$ and $b \in [-22.5, -21.5]$

$-15.00 - 22.00i$, which corresponds to just dividing the first term by the first term and the second by the second.

C. $a \in [-487.5, -486]$ and $b \in [1.5, 5]$

$-487.00 + 3.36i$, which corresponds to forgetting to multiply the conjugate by the numerator and using a plus instead of a minus in the denominator.

D. $a \in [7.5, 10]$ and $b \in [17, 18]$

$8.68 + 17.76i$, which corresponds to forgetting to multiply the conjugate by the numerator and not computing the conjugate correctly.

E. $a \in [-20.5, -18]$ and $b \in [83.5, 85]$

$-19.48 + 84.00i$, which corresponds to forgetting to multiply the conjugate by the numerator.

General Comment: Multiply the numerator and denominator by the *conjugate* of the denominator, then simplify. For example, if we have $2 + 3i$, the conjugate is $2 - 3i$.

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9. Simplify the expression below into the form $a + bi$. Then, choose the intervals that a and b belong to.

$$(4 + 6i)(3 + 10i)$$

The solution is $-48 + 58i$, which is option E.

A. $a \in [69, 79]$ and $b \in [22, 29]$

$72 + 22i$, which corresponds to adding a minus sign in the first term.

B. $a \in [-49, -46]$ and $b \in [-59, -56]$

$-48 - 58i$, which corresponds to adding a minus sign in both terms.

C. $a \in [11, 18]$ and $b \in [60, 68]$

$12 + 60i$, which corresponds to just multiplying the real terms to get the real part of the solution and the coefficients in the complex terms to get the complex part.

D. $a \in [69, 79]$ and $b \in [-25, -16]$

$72 - 22i$, which corresponds to adding a minus sign in the second term.

E. $a \in [-49, -46]$ and $b \in [58, 59]$

* $-48 + 58i$, which is the correct option.

General Comment: You can treat i as a variable and distribute. Just remember that $i^2 = -1$, so you can continue to reduce after you distribute.

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10. Choose the **smallest** set of Complex numbers that the number below belongs to.

$$\frac{\sqrt{165}}{8} + \sqrt{-10}i$$

The solution is Irrational, which is option A.

A. Irrational

* This is the correct option!

B. Rational

These are numbers that can be written as fraction of Integers (e.g., -2/3 + 5)

C. Not a Complex Number

This is not a number. The only non-Complex number we know is dividing by 0 as this is not a number!

D. Nonreal Complex

This is a Complex number $(a + bi)$ that is not Real (has i as part of the number).

E. Pure Imaginary

This is a Complex number $(a + bi)$ that **only** has an imaginary part like $2i$.

General Comment: Be sure to simplify $i^2 = -1$. This may remove the imaginary portion for your number. If you are having trouble, you may want to look at the *Subgroups of the Real Numbers* section.
